

What is claimed is:

1. A method of monitoring network performance with an end device communicating over interconnected heterogeneous networks, the method comprising:

- a) generating a datastream in a heterogeneous network with an end device, the datastream comprising a tracer packet;
- b) collecting network service information from at least one intermediate node within the heterogeneous network with the tracer packet;
- c) returning the tracer packet over the heterogeneous network to the end device; and
- d) interpreting the network service information in the tracer packet.

2. The method of claim 1, wherein a) comprises generating the tracer packet with a format substantially similar to an application data Internet protocol (IP) packet with the addition of heterogeneous access network tracking (HANT) data.

3. The method of claim 2, wherein heterogeneous access network tracking (HANT) data comprises at least one of a node-type field, a node-ID field, an attribute name field, an attribute value field, an attribute type field and a timestamp field.

4. The method of claim 2, wherein generating the tracer packet comprises filling a protocol field of the tracer packet with a heterogeneous access network tracking (HANT) protocol.

5. The method of claim 1, wherein a) comprises generating the tracer packet as a function of at least one of an automatic probe mode, a manual probe mode and an event probe mode.

6. The method of claim 1, wherein b) comprises:  
extracting the tracer packet from the datastream;  
storing network traffic conditions present at the at least one intermediate node in the tracer packet; and  
returning the tracer packet to the datastream.

7. The method of claim 1, wherein b) comprises identifying the network service information associated with the at least one intermediate node.

8. The method of claim 1, wherein the datastream comprises a plurality of packets and b) comprises routing the tracer packet as one of the packets.

9. The method of claim 1, wherein b) comprises selectively configuring the at least one intermediate node to recognize the tracer packet, wherein the tracer packet is unrecognizable by intermediate nodes that remain unconfigured.

10. The method of claim 1, wherein c) comprises:  
extracting the tracer packet from the datastream;  
writing network condition information into the tracer packet; and  
re-routing the tracer packet to return to the end device.

11. The method of claim 1, wherein d) comprises:  
deciphering the network service information; and  
presenting results on the end device.

12. A method of monitoring network performance with an end device communicating over interconnected heterogeneous networks, the method comprising:

- a) filtering a datastream passing from a first heterogeneous network to a second heterogeneous network to identify a tracer packet;
- b) probing a destination device operating in the second heterogeneous network for probing information as a function of the tracer packet;
- c) storing the probing information as network condition information in the tracer packet; and
- d) routing the tracer packet to an end device in the first heterogeneous network.

13. The method of claim 12, wherein a) comprises:

extracting the tracer packet from the datastream; and  
leaving the remainder of the datastream intact.

14. The method of claim 12, wherein b) comprises detecting at least one  
of, the function of the destination device, the type of destination device, the  
communication latency to the destination device and congestion around the  
destination device.

15. The method of claim 12, wherein b) comprises storing the probing  
information for use in another tracer packet.

16. The method of claim 12, wherein c) comprises  
storing network service information in the tracer packet as part of the  
network condition information.

17. The method of claim 12, wherein c) comprises:  
adding a segment to the tracer packet; and  
adjusting the value of a total length field in the tracer packet as a  
function of the added segment.

18. The method of claim 12, wherein c) comprises:  
modifying the length of a variable length data segment in the tracer  
packet; and  
adjusting the value of a total length field in the tracer packet as a  
function of the modified length.

19. The method of claim 12, wherein d) comprises exchanging a source  
address and a destination address in the tracer packet.

20. The method of claim 12, wherein the first heterogeneous network and  
the second heterogeneous network are interconnected and communicate over  
the core Internet.

21. A method of monitoring network performance, with an end device communicating over interconnected heterogeneous networks, the method comprising:

a) generating a datastream with an end device, the datastream comprising a plurality of data packets and a tracer packet each comprising a destination address of an application server;

b) routing the datastream over a heterogeneous network through an intermediate node;

c) selectively storing network service information in the tracer packet at the intermediate node;

d) removing the tracer packet from the datastream at a gateway;

e) gathering network condition information at the gateway as a function of the destination address of the tracer packet;

f) storing the network condition information in the tracer packet; and

g) routing the tracer packet back over the heterogeneous network through the intermediate node to the end device.

22. The method of claim 21, wherein a) comprises generating the tracer packet with a protocol identification different from the other data packets.

23. The method of claim 22, wherein b) and d) comprise identifying the tracer packet in the datastream as a function of the protocol identification.

24. The method of claim 21, wherein a) comprises tracking the time of departure of the tracer packet from the end device, wherein loss of the tracer packet is determined as a function of the time of departure.

25. The method of claim 21, wherein c) comprises writing network traffic conditions around the intermediate node into the tracer packet.

26. The method of claim 21, wherein e) comprises at least one of:  
determining the function and type of the application server;

detecting communication latency between the gateway and the application server; and  
detecting congestion at the application server.

27. The method of claim 21, wherein f) comprises:  
storing the network condition information in the gateway; and  
reusing the network condition information for future tracer packets directed to the same application server.

28. A network monitoring system for monitoring network performance with an end device communicating over heterogeneous networks, the network monitoring system comprising:  
a network comprising a first heterogeneous network communicatively coupled with a second heterogeneous network;  
an end device operable in the first heterogeneous network;  
an application server operable in the second heterogeneous network, the end device and the application server operable to communicate over the network with a datastream, the end device operable to generate a tracer packet as part of the datastream; and  
a gateway operable in the first heterogeneous network as an interface to the second heterogeneous network, the gateway operable to store network condition information in the tracer packet and redirect the tracer packet back to the end device over the first heterogeneous network.

29. The network monitoring system of claim 28, further comprising an intermediate node operable in the first heterogeneous network, the datastream operable to travel through the intermediate node, the intermediate node operable to store network service information in the tracer packet.

30. The network monitoring system of claim 28, wherein the end device comprises one of a wireless phone, a personal digital assistant (PDA) and a laptop computer.

31. The network monitoring system of claim 28, wherein the first heterogeneous network comprises a wireless network and the second heterogeneous network comprises a wireline network.

5 32. The network monitoring system of claim 28, wherein the first heterogeneous network is communicatively coupled with the second heterogeneous network via the core Internet.

10 33. The network monitoring system of claim 28, wherein the tracer packet comprises a source address, a destination address, a protocol field and heterogeneous access network tracking (HANT) data, the size of the heterogeneous access network tracking (HANT) data adjustable to accommodate variable amounts of data provided by the gateway.

15 34. The network monitoring system of claim 33, wherein the heterogeneous access network tracking (HANT) data comprises at least one of a node-type field, a node-ID field, an attribute name field, an attribute value field, an attribute type field and a timestamp field.

20 35. The network monitoring system of claim 28, wherein the end device comprises: a user interface component, an end device packet interception component, a traffic monitoring component, a packet decipher component, a tracer timer component, a packet sending component, a packet generator component, a probing trigger component and an event generator component.

25 36. The network monitoring system of claim 29, wherein the intermediate node comprises: a packet interception component, a packet manipulation component and a status component, the status component operable to store and maintain statistical information related to the intermediate node.

30 37. The network monitoring system of claim 28, wherein the gateway comprises: an administration interface component, a gateway packet interception component, a gateway packet monitoring component, a probing

component, a gateway status component and a gateway packet manipulation component.

- 5        38.     The network monitoring system of claim 28, wherein the end device comprises an end device network monitoring module, the end device network monitoring module operable in a network stack between a transport layer and a network layer.

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